

CALIFORNIA WATER RESEARCH



Water Supply for Diversions in the Delta
by the Central Valley Project and the State Water Project

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The Bureau of Reclamation and Water Rights Conflicts

In 1951, the U.S. Bureau of Reclamation completed the Delta Cross Channel and the Delta-Mendota Canal, and began sending water south. That same year, the State Engineer, A.D. Edmonston, introduced the plans for the Feather River and Delta Project. But by 1952, it was clear that there were significant conflicts between the diversions by the U.S. Bureau of Reclamation and the existing rights of riparian and pre-1927 water users along the Sacramento River and in the Delta, let alone the proposed diversions by the state for what would become the State Water Project. A Memorandum of Understanding was signed in July 1952 to undertake a cooperative investigation of the existing water rights and water diversions along the Sacramento River and in the Delta. The results of the investigation were published in a 1957 “Report on 1956 Cooperative Study Program.”¹ The report evaluate the deficiency in water supply for existing water diversions ussing several sets of alternative assumptions about pre-1927, riparian, pre-1938, and post-1938 water diversions.

To evaluate the deficiencies, the report used estimates of

“... modified natural flows that would have existed at the major gaging stations along the Sacramento River and at other points if diversions from the river had not been made, but if certain assumed diversions from tributaries to the river and to the Delta had been made.”²

The estimates were made for the months of April through October from 1924 through 1954.

To estimate deficiencies, the study deducted gross diversion from “modified natural flows available in various reaches” and credited “amounts of return flow available from such diversions.” The results showed large deficiencies in average flows in the Sacramento River and the Delta in the months of July, August, and September needed to meet the existing irrigation needs of water rights holders, given the 1954 and 1955 diversions by the Bureau of Reclamation along the Sacramento River and in the Delta., and that supplemental water supply would have to be released from upstream reservoirs. It was also found that supplemental releases for salinity control in the Delta would also be required.

¹ : Report on 1956 Cooperative Study Program: Water Use And Water Rights Along [The} Sacramento River And In [The] Sacramento-San Joaquin Delta, US Department of Interior, Bureau of Reclamation, State of California, Department of Water Resources, Sacramento River and Delta Water Association, 1957, Vol. I & II

² Report on 1956 Cooperative Study Program, Vol. I, p. 8

Table 15 and 16 (Vol I, p.89, reproduced below) show the average deficiencies in water supply for the 31 year study period.

TABLE 15

SUMMARY OF THE 31-YEAR AVERAGE DIFFERENCE BETWEEN THE YIELD OF ALL ASSUMED RIGHTS OF THE LOCAL WATER USERS ALONG THE SACRAMENTO RIVER ABOVE SACRAMENTO AND THE 1954 LEVEL OF DIVERSIONS. SACRAMENTO RIVER IRRIGATION DEFICIENCY

In thousands of acre-feet								
Study	Apr.	May	June	July	Aug.	Sept.	Oct.	Total
A-1	0	17	12	79	78	0	0	186
A-2	0	17	12	79	78	0	0	186
A-2 Modified	0	17	12	79	78	0	0	186
B-1	0	24	48	249	321	142	3	787
B-2	0	24	48	250	321	145	3	791
B-2 Modified	0	25	48	250	321	145	3	792
B-3	0	18	39	218	300	84	0	659
B-4	0	17	21	154	225	17	0	434

TABLE 16

SUMMARY OF THE 31-YEAR AVERAGE DIFFERENCE BETWEEN THE YIELD OF ALL ASSUMED RIGHTS OF THE LOCAL WATER USERS IN THE DELTA UPLANDS AND LOWLANDS AND THE 1955 LEVEL OF DIVERSIONS. DELTA IRRIGATION DEFICIENCY

In thousands of acre-feet								
Study	Apr.	May	June	July	Aug.	Sept.	Oct.	Total
A-1	0	2	13	107	159	14	0	295
A-2	0	3	13	107	160	14	0	297
A-2 Modified	0	4	13	107	160	14	0	298
B-1	0	4	11	65	82	34	1	197
B-2	0	4	11	65	82	34	1	197
B-2 Modified	0	5	11	65	82	34	1	198
B-3	0	3	10	62	79	20	0	174
B-4	0	1	7	48	69	5	0	130

The "B" series, which showed the highest average deficiencies along the Sacramento River of 787,000 – 792,000 af/year, and 197,000-198,000 af/year in the Delta, assumed priority of riparian water rights. The report described the assumptions as follows:

“In the "B" Series all of the assumed riparian rights, both above Sacramento and in the Delta lowlands, and the salinity control requirement, when it was taken to have a riparian water right status, were taken as being satisfied before any appropriative water rights. After such riparian rights were satisfied to the extent of available water supplies, the remaining flows at points along the Sacramento River and in the Delta were assumed to be available to satisfy appropriative water rights.”

The "A" series had the most favorable assumptions for the Bureau of Reclamation, ranking the 1927 and 1938 applications by the state for diversions by the Bureau of Reclamation at the same priority as that of the riparian diverters, which ignored the state's area of origin statute. The "A" series also assumed satisfaction of water rights in order from north to south. Not unexpectedly, the "A" series showed the highest deficiencies of irrigation water for riparian users in the Delta lowlands, an average of 295,000-298,000 af/year. The study did not explicitly address the possibility that the Bureau of Reclamation's diversions would have to be reduced. Plate 9 (reproduced below) shows a graph of the deficiencies.

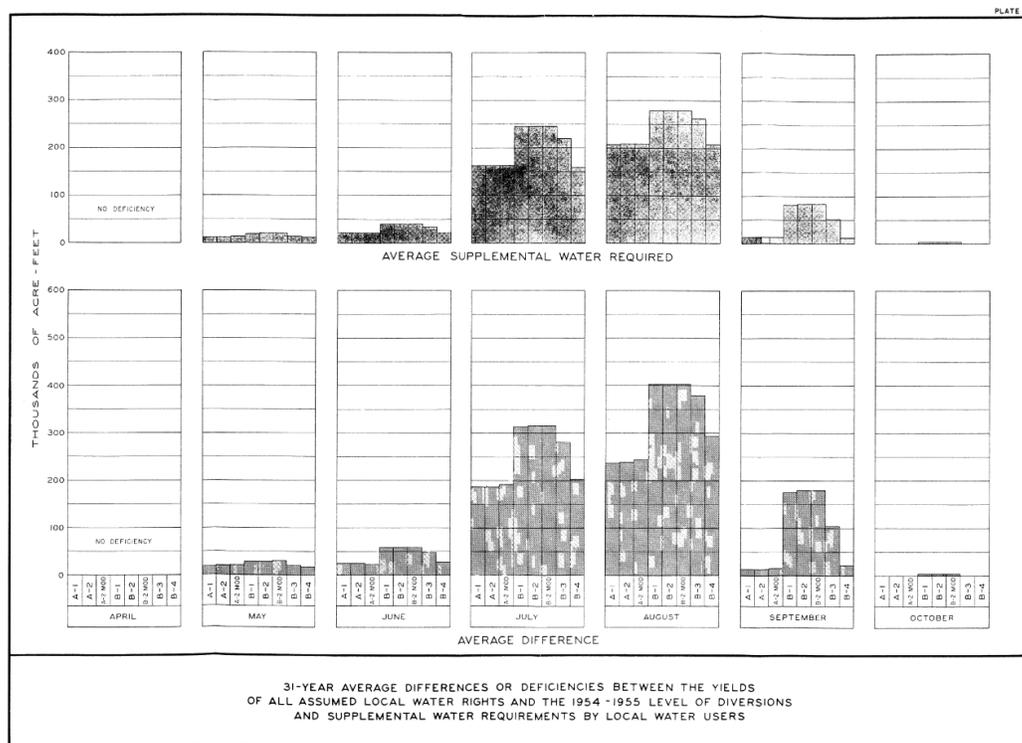


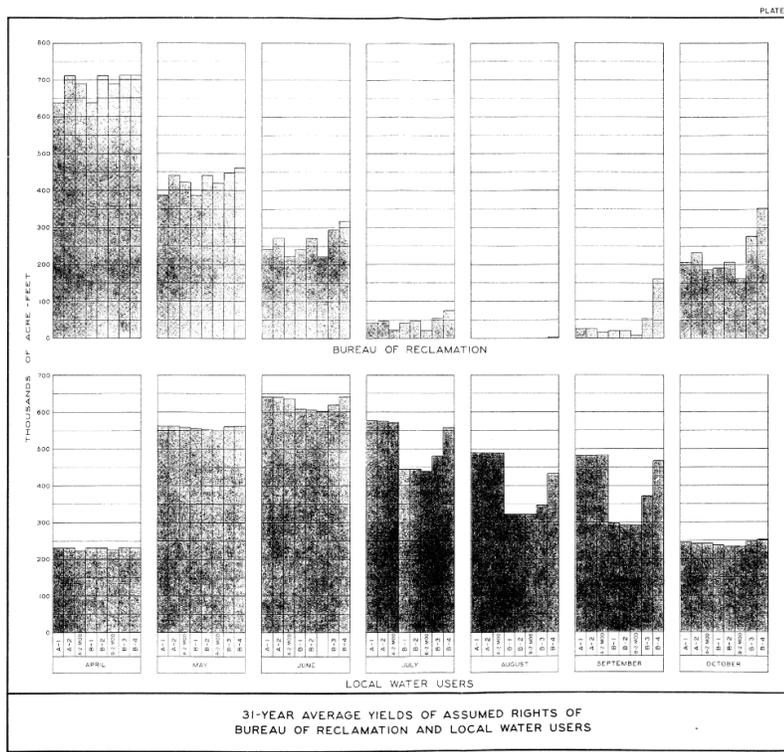
Table 11 (Vol. I, p.85, reproduced on the next page,) shows the yield of the Bureau of Reclamation's 1938 application for diversion of up to 4,000 cfs in the Delta in the months from April to October. The total yield under different assumptions is mostly below 500,000 af/year. Plate 8 (reproduced on the following page) is a graph of the average computed water diversions for the Bureau of Reclamation and local water users under the different water rights assumptions..

It should be noted that the numbers in these tables only considered average amounts of water available for diversion, and did not specifically address the issue of water available in dry and critically dry years, when there would be the greatest conflict between the Bureau's proposed water diversions and the needs of the areas of origin.

TABLE 11

SUMMARY OF VALUES AND 31-YEAR AVERAGE YIELDS OF THE ASSUMED
1938 DIRECT DIVERSION RIGHT OF THE UNITED STATES IN THE DELTA

		<u>In thousands of acre-feet</u>							
		: Apr.	: May	: June	: July	: Aug.	: Sept.	: Oct.	: Total
		<u>Assumed rights</u>							
Study A-1	VARIABLE								
	A-2	"							
	A-2 Modified	"							
	B-1	"							
	B-2	"							
	B-2 Modified	"							
	B-3	"							
	B-4	"							
		<u>31-year average yields</u>							
Study A-1		9	17	74	28	0	0	26	154
	A-2	109	110	128	38	0	2	98	485
	A-2 Modified	97	91	80	11	0	1	68	348
	B-1	9	18	73	28	0	12	30	170
	B-2	109	112	127	38	0	15	87	488
	B-2 Modified	97	90	80	11	0	3	57	338
	B-3	111	117	143	41	0	38	136	586
	B-4	111	130	168	61	3	114	198	785



Decision 990

When the State Water Resources Board held hearings on the Bureau's applications for diversions from 1959-1961, the Bureau promised to deal with the issues of over-allocation of water along the Sacramento River and the Delta by supplementing Sacramento River flows with from the contracted, but not yet built, American River and Trinity divisions, and by coordinated management of all reservoirs.

D990 quoted the Bureau of Reclamation's promise that water from the American River division would supplement "releases from Shasta Reservoir to provide the required inflow to the Delta (RT 367-371)."³

D990 also quoted the Bureau as stating that "Trinity River Water is to be imported in to the Sacramento Valley to supplement the water supplies developed by the other divisions of the Project."⁴

D990 specifically addressed the promise by the Bureau to provide upstream releases to satisfy export its Delta export requirements without impacting downstream users:

³ Decision D990, p. 17

⁴ Ibid.

“To be able to export sufficient quantities of water to Mendota Pool, it is necessary to supplement the uncontrolled inflow to the Delta with stored water (RT 1717-20). Similarly, the requirements of the Sacramento Valley must be met. The conservation of water to satisfy these demands requires that the multi-purpose reservoirs of the Project – Shasta on the Sacramento River, Folsom on the American River, Trinity on the Trinity River and Whiskeytown on Clear Creek – be integrated in their operation and coordinated with the unregulated downstream inflow (RT Vol 18, p. 2373). It is on this basis that the United States intends to provide adequate water supplies.”⁵

Decision 990 specifically considered the lack of water supply for the proposed diversions in the summer months:

With respect to the availability of water along the Sacramento River from Shasta Dam to the Delta and in the channels of the Delta, Study C-2BR indicates that no water is available during August and only infrequently available during July. Study C-650D indicates that September is also a month of questionable supply (USBR 139 and SRDWA 39).⁶

Decision 990 states that other evidence was presented by the Bureau of Reclamation and the Department of Water Resources about return flows:

However, the Bureau presented evidence that because of return flows from applied Project water, there will be unappropriated water available in various reaches of the River below Keswick Dam and in the Delta year-round. This evidence is corroborated by testimony submitted by the Department (RT 10928-30).⁷

However, the 1956 Cooperative Study Program report had already included generous estimations of return flows in its calculations. Decision 990 stated:

There is no doubt that Project water applied to lands which drain into channels tributary to the Delta will provide additional return flows, but the quantities cannot be predicted with any degree of accuracy (RT 10972-75). Return flows from applied Project water will enter the Sacramento River at various points below Keswick Dam (USBR 164). It appears proper, therefore, to allow a year-round direct diversion season at points below Shasta Dam as requested by the Bureau.⁸

But the Board continued:

⁵ Decision D990, p. 18

⁶ Decision D990, p. 31

⁷ Ibid.

⁸ Decision D990, p. 32

Any necessary reduction in the season can be made at the time of licensing when the project is fully developed and the extent of return flow can be more accurately determined.⁹

The Board only briefly considered the issue of the amount of water available in dry and critically dry years, and the needs of local water users. It was estimated that there was a deficiency of 2,349,000 acre-feet during a year similar to 1924. The Bureau testified that an addition 2,500,0000 acre feet was necessary to assure water rights for the area of origin, but no explicit commitments were made for acquiring the required water.

In affirming the application amounts for direct diversion from the Sacramento River and the Delta, a Board member noted:

In fixing the rates of direct diversion to be allowed, the Board is inclined to greater liberality than usual because of the magnitude of the Project and the complexities involved in determining at this time the direct diversion as distinguished from rediversion to be allowed, the Board is inclined to greater liberality than usual because of the magnitude of the Project and the complexities involved in determining at this time the direct diversion as distinguished from rediversions of stored water. However, notwithstanding these considerations, we would require greater particularity in proof of direct diversion requirements were we not assured that no prejudice to others will result from failure of applicant to produce such proof. This assurance is provided by conditions which will be imposed in the permits subjecting exports of water from the Delta to use within the Sacramento River Basin and Delta so that there can be no interference with future development of these areas.¹⁰

The Board member did note the conflict with the existing diversion rights on the Sacramento River, but stated:

It should be apparent, in the light of the evidence introduced at the hearing, that the problem of claimed rights and their amounts is of no concern to the Board, once the pertinency of the Watershed Protection Law is established, including a provision that the Sacramento Valley and Delta lands are to be guaranteed water by contract before stored water from Shasta Dam is exported to the San Joaquin Valley.¹¹

⁹ Ibid.

¹⁰ Decision D990

¹¹ Decision D990

However, no contract with Central or South Delta water agencies was ever reached, and supplemental water supplies from the Trinity River division went to users in the San Joaquin Valley, not to firming up the water supply for the Bureau's existing diversions along the Sacramento River and in the Delta. Promises had been made to San Joaquin Valley users, and, when Trinity dam was finally completed in 1963, the Bureau signed new contracts with Westlands Water District and other San Luis Unit Districts.

The contract amounts for Westlands were originally for 600,000 to 900,000 acre feet per year, depending on groundwater conditions in the District. In 1980, the contract was set at 900,000 acre feet per year, and in the Barcellos judgement of 1986 increased that amount to 1,150,000 acre feet per year.

These size of the existing contracts by the Bureau with San Joaquin Valley exceed the Bureau's supply in most years. This has created huge conflicts with beneficial needs in the Sacramento River and the Delta, including irrigation, navigation, and fish and wildlife.

The Board should re-visit the issue of water supply for the Bureau of Reclamation permits, given the vastly more sophisticated monitoring information and computer models that are available, as well as the issue of climate change and maturity of water rights in the areas of origin.

The State Water Project Water Supply

The State Water Project had even worse conflicts than the Bureau of Reclamation with respect to water supplies for permitted diversions. At the hearing for Decision D990, it became clear that the water supply for applications by the Bureau of Reclamation assumed the entire flow of the Feather River:

The Bureau presented its most recent plans for the Central Valley by exhibit USBR 164. The water supply used in making this study consisted of the Trinity River importations, Sacramento River, Shasta Reservoir Unit and the American River unit of the Central Valley Project. The Board had granted permits to the United States previous to this hearing on the Trinity, American and San Joaquin Rivers. The entire flow of the Feather River was included as a tributary of the Sacramento River.¹²

At this point the hearing was recessed at the request of the state's attorney. During the following months, the Department of Water Resources and the Bureau of Reclamation worked out the first Coordinated Operating Agreement. In Article 12, the parties agreed to divide unappropriated water in the Delta in the ratio of basis of total diversions under applications permits, which were then 8,300,000 acre feet per year for the Bureau, to 5,260,000 acre feet per year for the Department of Water Resources,

¹² Decision D990, p. 57-58

and to similarly allocate any shortages.¹³ The Board decided that this was sufficient to issue the permits for the Bureau of Reclamation diversions.

The Board did note that

“the variances between the Bureau’s Central Valley Project and the Department’s Feather River Project of 1951 and the plans presented at the hearing, involving no more water than was available in 1951 (except for the Trinity River diversion) poses a problem that cannot be solved by the Board. All it can do is maintain continuing jurisdiction until the Department receives its permits for the State Water Plan and has arrived at an operational agreement with the Bureau as proposed in the testimony of the Director of the Department.”¹⁴

The State Water Project Water Contracts

Ironically, while the state’s attorney was negotiating on the duplication of the water supply with the Bureau of Reclamation, the problems were being made much worse by negotiations for contracts for water from the State Water Project. Contracts negotiated with Metropolitan Water District in 1959 gave MWD 2 million acre feet per year, most of the estimated “dependable yield” of the facilities that were authorized by the Burns-Porter Act that year. These facilities included Oroville Dam and the Banks pumping plant in the Delta. Bill Warne, the Director of the Department of Water Resources, set out to sign contracts with other water agencies for another 2 million acre feet. By the time the final contract was signed in 1962, the contracts totaled 4.23 million acre feet a year, which was almost twice the estimated yield of the project. The Department of Water Resources assumed that the remaining upstream supplies for the State Water Project were to come from augmentation of Sacramento River flows from North Coast rivers and streams.

Bill Warne, the director for the Department of Water Resources from 1961-1966, was interviewed by Malca Chall in 1979 for the Governmental History Documentation Project. He discussed the fact that the State Water Project only had about half the upstream water supply it needed for the contracts with the existing facilities, and the need for augmentation of Sacramento River flows.¹⁵

¹³ State Water Board, Decision 990, p. 59 Available at http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d0950_d0999/wrd990.pdf

¹⁴ Ibid., p. 62

¹⁵ Bancroft Library, Regional Oral History Office, Governmental History Documentation Project, Goodwin Knight / Edmund Brown, Sr., Era: California Water Issues, 1950-1966, William E. Warne, Administration of the Department of Water Resources 1961-66, p. 104 Available at <http://archive.org/details/califwatertapere00chalrich>

Plans for Augmenting the Flows of the Sacramento River System:
The North Coast

Chall: As I understood it, one of the reasons you were able to offer the additional acre-feet of water to the Metropolitan Water District was because of a plan at that time to augment the water in the Delta from the north coast.

Warne: Our expectation of augmenting the flows of the Sacramento River system that expectation dated clear back to the Burns-Porter Act itself. That didn't arise simply by reason of the fact that we were going to up the four million acre-feet per annum to 4,230,000 acre-feet.

We were only in a position to guarantee, even with Oroville Dam, about half of the four million acre-feet without additional works.

Chall: Only half; I didn't realize that.

Warne: Unless we could augment the supply. Now, there were several ways the supply could be augmented. We could augment it in part by getting better control in the Delta, which the Peripheral Canal would do. We could augment it by developing some additional waters in the Sacramento Basin itself, such as on Cottonwood Creek, which was one of the proposals.

We even had a dam named Ishi up there. They haven't built it yet, but it's there. Then we could augment it by bringing water in from the Eel River or through the Glenn complex. The Glenn complex was planned at that time and is still planned to capture some additional water in the Stony Creek Basin and also to make it possible to bring more water in from some tributary of the Trinity, or eventually, the Klamath itself. Also, it could be used for off-stream storage to conserve more Sacramento River flood waters.

We had a multitude of plans, some of them far out. Some of them not involved in any way in supplying the necessary roughly two million acre-feet more water that we were going to need by the time the State Water Project got to its full maturity.

Chall: May I just interrupt you a minute? I want to see if I can understand this completely. In 1980, was it, when the initial California Water Plan is supposed to have been completed out of the Burns-Porter Plan?

Warne: Not completed. That was the year the water was all going to be used.

Chall: All going to be used. And is that amount of water only two million some acre-feet, or was it supposed to be four?

Warne: No, that amount of water was 4,230,000 acre-feet.

Chall: And that was supposed to come from...?

Warne: About half of it would have to be through augmentation

Chall: From the Feather River? From the Oroville and its conduits?

Warne: No. The Oroville reservoir didn't produce anywhere near that much. The Oroville reservoir and the unallotted waters in the Sacramento Basin only provided about half of the four million. We always intended the law itself says that you're to build additional facilities. The law requires the offset of certain bonds in order to have money to build the additional facilities.

Chall: Yes, I understood that, but I always thought that that was in addition to the four million.

Warne: No. Oh, no. Oh, no. Not in addition to the four million. In addition to the yield of the initial facilities, which provide about half of the total amount.

Chall: I see.

Warne: So when we went for 230,000 more, we were only increasing fractionally, really, something over ten percent, the additional amount that was going to have to be developed.

Now, mind you, as long as the federal Central Valley Project Isn't using all of its allotted water, you have the same situation that you had on the Colorado River. Arizona wasn't using all its waters, so someone else could use it in the interim.

Two years after the 1979 interview with Warne, Bulletin 76-81 confirmed Warne's assertion:

Need for Additional Dependable Water Supply

In studies leading to Bulletin 76, it was established that the present dependable water supply (firm yield) of the existing SWP facilities is 2.8 million dam³ (2.3 million ac-ft) per year. By the year 2000, this will decrease to about 2.0 to 2.2 million dam³ (1.6 to 1.8 million ac-ft) per year as a result of increased water use in the areas of origin, maturity of contractual obligations of the federal Central Valley Project, and other prior rights.¹⁶

Why the North Coast Area Investigation Largely Failed

In DWR Bulletin 151-65, "Water Progress in California, July 30, 1962- June 30, 1965" William Warne described the North Coast projects that the Department of Water Resources envisioned to supply the remaining two million acre feet:

"Plans for the further development of surface waters are equally important. In 1964 for example, the Department completed a seven-year long-range planning study of the north coast. One result was the selection of a site for the initial north coastal conservation facility of the State Water Project. This will be the Upper Eel River Development. This will be followed by projects in the Trinity River, the Lower Eel River, and the Klamath River—projects which will carry into the next century. The plans for that century are being laid today."¹⁷

The bulletin went on to state:

¹⁶ California Department of Water Resources, Bulletin 76-81, Status of Water Supply Augmentation Plans, 1981, p. 6.

¹⁷ California Department of Water Resources, Bulletin 151-65, Water Progress in California, July 30, 1962- June 30, 1965, p.3 Available at <http://archive.org/details/q4waterprogressinc15165calirich>

Unless north coast streams are developed, supplies of water to the Delta—and to State Water Project contractors— eventually will diminish. They will diminish as developing areas along Sacramento and San Joaquin River tributaries require more and more water to satisfy their own needs.¹⁸

The map on the next page, from the rear cover of Bulletin 151-65 shows the North Coast dams and 40 miles of tunnels that were envisioned. But by the time that Bulletin 151-65 was issued, it had become apparent that most of the water supply plans were in serious conflict with prior water rights and needs of the North Coast areas of origin.

The North Coastal Area Investigation had been commissioned by the state legislature in 1956 to look for supplemental sources of water for the State Water Project. A report of the findings was published in 1964.¹⁹ The report found that diversion of water from the Klamath River faced huge obstacles. Early speculation about water supply from the Klamath had not taken into account prior rights by local farmers and the Bureau of Reclamation in the upper Klamath watershed. In 1953 the States of California and Oregon negotiated an agreement regarding diversions in the Upper Klamath watershed, which barred diversion outside of the Upper Klamath River basin. The Klamath River Compact was ratified in 1957. The 1964 report only considered a plan to build a dam on the lower Klamath River, and indicated it was the lowest priority for consideration by the Department of Water Resources because of impacts on Klamath River salmon runs. Any plans for a dam on the lower river would also have run afoul of fishing rights of the Yurok tribe.²⁰

The proposal of additional supplies from the Trinity River were completely unrealistic. Plans for augmentation of Sacramento River flows from the Trinity had been included in the original Feather River Project plans when they were introduced by the state engineer, A.G. Edmonston, in 1951. But the next year, the Bureau of Reclamation had submitted a proposal to the Eisenhower administration to construct Trinity dam. In December 1954 Edmonston objected that the Bureau's Trinity project would interfere with the state's plans for the Feather River Project. But there was opposition from both Trinity County and the San Joaquin Valley to including the Trinity River in the State Water Project. Edmonston lost the battle, and the Trinity River Division Act was passed by Congress in 1955. In 1957 the Department of Water Resources assigned the permits for Trinity River diversions to the Bureau of Reclamation. The Bureau completed Trinity dam in 1963 and began diverting 75- 90% of the river flow at Lewiston.²¹

The Department of Water Resource's remaining hope to augment Sacramento River flows, and provide some of the needed two million acre feet for its existing contracts, was a dam on the Eel River. The North Coastal Area Investigation had found that the most realistic prospects for additional State Water Project water supply were diversion dams on the Eel, Van Duzen, and/or Mad Rivers, which had much more limited potential yield than the Trinity River.²² The Department of Water Resources completed plans for the Dos Rios Dam, a reservoir on the upper Eel River with an initial estimated yield of 750,000 to 800,000 acre-feet per year. However, the yield studies assumed diversion of 80% of the river flow,

¹⁸ California Department of Water Resources, *Water Progress in California*, p. 5

¹⁹ California Department of Water Resources, *North Coastal Area Investigation*, 1964, p. 11

²⁰ Hoopa Valley Tribal Fisheries, *History of the Trinity River 50,000 acre-feet*, Available at <http://www.hoopafisheries.org/13501.html>

²¹ Dane J. Durham, "How the Trinity Lost It's Water" *Ibid.*

²² *North Coastal Area Investigation*, op. cit.

and did not sufficiently account for prior rights of the Potter Valley Project, or rights of the Round Valley Indian Tribe.²³

Decision D1275 and Water Supply for the State Water Project Permits

By 1966, when the State Water Board held a hearing for Decision 1275 on the applications by the State Water Project, the issue of water supply for the State Water Project was still unresolved. Decision D1275 states that

“The primary and most controversial issues raised at the hearing were:

- (1) What quantity of unappropriated water is available in the Delta to supply the Department?
- (2) What quality of water in the Delta should be maintained to protect prior rights?

These issues are interrelated and an analysis of the quantity of water available must take into consideration the quality to be maintained.”²⁴

The Board continued:

The Department presented a study of the coordinated operation of the Federal Central Valley Project and the State Water Project for the 33-year period 1921 through 1954 (DWR Exh. 80) based on the following assumptions:

- (1) 1,800 cfs Delta Outflow
- (2) Upstream depletions at the level of projected development in the year 2015
- (3) Augmentation of the Delta by construction of additional facilities to offset future depletions in the Delta.

The third assumption appears reasonable as the Upper Eel River development, authorized by the Department in 1964, will yield an amount of water to meet projected depletions in the year 2035 as shown by Table 5 of Department Bulletin 132-66 (DWR Exh. 55).

In making the decision to grant the applications by the Department, the Board relied on a joint study which showed that

“supplies would have exceeded demands in at least one month in all but two years. In the years when supply would have exceeded demand, the excess ranges from 15,000 to 27,655,000 acre-feet, and in 50 percent of the years there was at least 4,820,000 acre-feet excess.”

Unfortunately, the Board decision does not separately break out the amount of water expected to be available in the Feather River, and the amount of water expected to be available in the channels of the Delta. Nor does it consider the amount of water available in dry and critically dry years, and the prior water rights.

²³ North Coastal Area Investigation, op. cit.

²⁴ State Water Rights Board, Decision D1275, p 16

It should be noted that the requirements for Delta outflow in the studies by the Department of Water Resources were also extremely low. Most of the assumptions in the 1956 Cooperative Study had set Delta outflow at 3,300 cfs, as recommended in the state's Bulletin 27, "Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay," published in 1931. The flow was estimated to be necessary to keep chloride below 1,000 parts per million near Antioch. Studies of fish and wildlife needs since the decision have also indicated that minimal outflow needs for the Delta and Suisun Marsh are much larger than 1,800 cfs.

The assumption of the construction of the proposed dam on the Upper Eel River, which was used in the Department's study, was also speculative, since the project had not been approved by then-Governor Reagan or by the legislature. At the time of the hearing, the dam had become hugely controversial because it was going to flood 18,000 acres in Round Valley, displacing 1,050 people in the community of Covelo and 350 residents of the Round Valley Indian Reservation.²⁵ In 1968, Governor Reagan mandated the development of alternatives to the dam. In 1972, the state legislature designated the Eel River as a Wild and Scenic River, as well as portions of the Klamath, Smith, and Trinity rivers. The Upper Eel River project was never built.

In spite of these issues, the Board approved the application of the Department of Water Resources based on this study. However, the Board retained jurisdiction for the purpose of setting salinity standards, fish and wildlife protection, and coordination of the CVP and SWP operations.

The Board also noted:

Reasonable protection to the Delta water users requires some winter flushing flows, a fairly high quality of water during the early irrigation season, and no degradation of the quality of water below natural conditions during the summer and fall seasons when the natural flow is low.

The Department proposes to commence the diversion of a relatively small quantity of water in 1967, and to gradually increase diversions over a period of approximately 20 years.²⁶

The issue of the water supply for the permitted diversions by the Department of Water Resources has never been revisited. The decision should be revisited, given the lack of development of adequate upstream supplies. Climate change modeling on DWR has shown that there will likely be a significant impact on reservoir storage.

Climate Change Impacts on Reservoirs

The graph below, from the 2006 California Climate Assessment, is an exceedance plot for end of year carryover storage.²⁷

²⁵ California Department of Water Resources, California Water Plan, 1970.

²⁶ State Water Rights Board, Decision D1275, p 19

²⁷ Progress on Incorporating Climate Change into Management of California's Water Resources. Department of Water Resources, 2006. Available at <http://www.water.ca.gov/climatechange/docs/DWRClimateChangeJuly06.pdf>

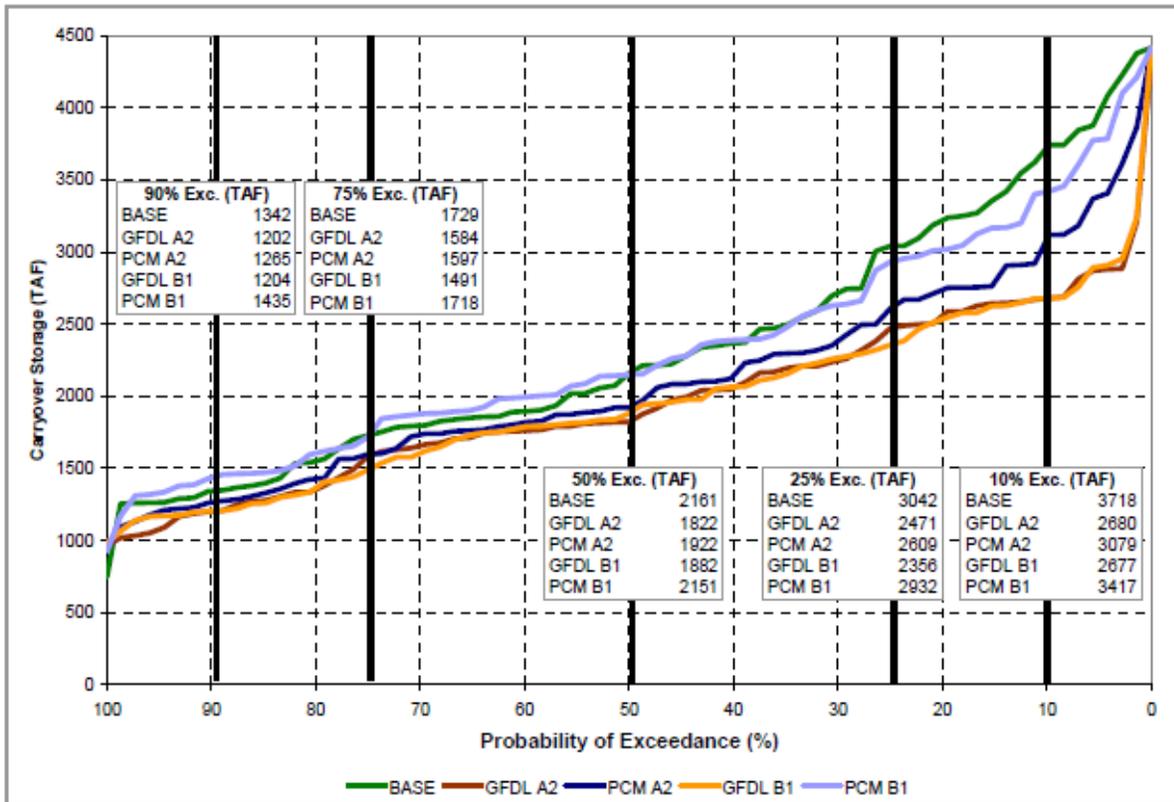


Figure 4.6 Exceedance Probability Plot of SWP Carryover Storage

The modelers noted, “Overall, with the drier climate scenarios, less water was delivered to Table A contractors and more risk with SWP carryover storage was taken to do it.”²⁸ Of particular concern were the number of months of dead storage in upstream reservoirs. These were months when basic demands for water supply for area of origin needs in the Sacramento Valley could not be met.

The table below shows the estimated number of months of dead storage:²⁹

Table 4.13 Months of Critical Shortages (Storage at Dead Pool)

	Shasta (months)	Oroville (months)	Folsom (months)
BASE	1	0	1
GFDL A2	31	0	28
PCM A2	29	0	22
GFDL B1	21	0	20
PCM B1	0	0	0

This was of particular concern, because the modeling did not attempt to meet current requirements for Sacramento Valley instream flows to protect salmon. These are the mandated releases under CVPIA

²⁸ Progress on Incorporating Climate Change into Management of California’s Water Resources, op. cit.

²⁹ Ibid.

section 3406b(2). The modeling also only used the 2020 level of land development, and only sought to meet 2025 demands for water by Sacramento Valley water users.



Folsom reservoir in 2009, nearing dead pool. Source: Bureau of Reclamation

The Folsom Reservoir is also the water supply for the city of Folsom, and the “dead pool” months would have severe impacts on the city’s water supply. According to the city of Folsom 2010 Integrated Regional Water Management Plan Update, the city currently has 64,000 people, and the population is expected to increase to 97,000 by 2035.

In the 2006 report on climate change modeling, the modellers concluded:³⁰

The length of shortages in GFDL A2, PCM A2, and GFDL B1 indicate that the delivery results presented for these scenarios in the next section are not always reliable. Too much risk was taken in the delivery allocation decisions of these three scenarios and not enough storage was carried into the drought periods as a result. In future climate change simulations, modifications to the rule that divides available water into delivery and carryover should be investigated as a means to prevent these shortages. Since CVP allocations are dependent on Shasta and Folsom storage, such modifications will likely alter the resulting delivery capability of the CVP as compared to the results presented in the next section.

BDCP and Upstream Storage

BDCP modelers are also reporting severe problems with upstream storage.

³⁰ Progress on Incorporating Climate Change into Management of California’s Water Resources.

In 2010, Francis Chung, head of the DWR climate change modelling team, presented results on modeling for BDCP at the California Water and Environmental Modelling Forum at Asilomar.³¹

Chung showed results from a range of models, including the proposed operations under the “Preferred Project” with a 50% probability of exceedance of 5.5 MAF/year SWP and CVP exports. The models showed that there was a huge increase in months with dead storage in North of Delta reservoirs. The Table is reproduced below.

Numbers of Dead Storage Months for North-of-Delta Reservoirs from Climate Change					
Scenario	Trinity	Shasta	Oroville	Folsom	Total
D1641	3	6	0	6	15
(+) Wanger with CC	9	24	21	25	79
(+) BDCP with CC	12	21	10	39	82
(+) NODOS with CC	15	24	17	42	98
(+) SOD GW Bank with CC	17	27	23	46	113

Chung concluded, "Results appear to be unsustainable. The relative frequency of dead storage conditions in upstream reservoirs indicate that significantly modified operations will be required with climate changed conditions." and went on to say,

"We recommend that DWR develop a reoperation strategy for the CVP and SWP that includes modified operations scenarios to mitigate the effects of dead storage during climate change conditions prior to release of any studies (either these or BDCP) that include climate change."³²

The Board needs to explicitly revisit the issue of water supply for the State Water Project’s existing permit. It is clear that assumptions about upstream supplies in the original study were overly optimistic. In addition, as was noted in the section of these comments on the Bureau of Reclamation permits, conflicts with the water rights of local users have never been resolved, and will be getting worse because of climate change and maturity of water rights in the areas of origin. The Board must explicitly consider the issue of water supply for permitted diversions in dry and critically dry years, when the conflicts are expected to be the worst, and the issue of water supply for the needs of the area of origin.

³¹ Francis Chung, An Assessment of CVP-SWP Performance Under Alternative Delta Regulations, Infrastructure and Climate Change Scenarios Regarding CAISiM II, California Water and Environmental Modelling Forum, Feb 22, 2010. Available at <http://www.cwemf.org/Asilomar/FrancisChungCWEMFPres.pdf>

³² Ibid.

Summer Diversions by the State Water Project

As noted in previous comments, Decision 1275 originally excluded July, August, and September from the allowed season of diversion for the State Water Project. Decision D1291 discusses the reasons:

Decision D 1275 excluded July, August, and September from the authorized seasons of diversion from the Delta. The reason for excluding these months, discussed in the decision beginning on page 26, was that the studies introduced by the Department at the hearing (Exh. 72 and related exhibits) showed that unappropriated water would have been available in the Delta during these months in only a few years during the 30-year period of study and then only in small quantities.

The Department contended in its petition that greater quantities of unappropriated water than were indicated by its previous studies will be available in the Delta for several years because the actual in-basin use of water will be less than the assumed in-basin rights due to the fact that some rights are still in a development period and all in-basin rights will not be utilized simultaneously at maximum rates.

The Department's exhibits and testimony demonstrated that for several years substantial quantities of unappropriated water will probably occur in the Delta during July, August, and September that were not indicated by the evidence which was the basis for deleting these months from the seasons of diversion in Decision D 1275.

The Department of Water Resources produced the following table of water available for export in five of the 15 years between 1952 and 1967.³³

	<u>July</u>	<u>August</u>	<u>September</u>
1952	985	296	441
1956	410	250	568
1958	632	411	693
1965	252	340	606
1967	1,358		

These numbers were based on new assumptions about consumptive use in the Delta which were never checked. The State Water Board decision only stated that, "the magnitude of the quantities assures that there will be substantial water available in the Delta with an average frequency of one year in three even if the assumptions are in error by relatively large percentages."³⁴

As was noted in the comments on Decision 990 and the Bureau of Reclamation permits, the issue of water supply for direct diversions in the Delta (as opposed to rediversions of stored water) has never been resolved, nor the issue with conflicts with local needs. Supplemental water supplies have either not been

³³ Decision D1291

³⁴ Ibid.

acquired, or been committed to new contracts. With climate change and maturity of water rights in the areas of origin, the conflicts brought about by the over-allocation of water will only be getting worse. The Board needs to explicitly revisit the issue of water supply in the summer months for both the Bureau of Reclamation and the Department of Water Resources permits.

Impacts on the Estuary of Over-Allocation: Reversal of Delta flows

The permits that were issued to the US Bureau of Reclamation and the Department of Water Resources for direct diversions in the South Delta greatly exceeded natural supplies in the channels of the Delta in many years. The biggest impact of this over-allocation was a more and more extreme reversal of normal Delta outflows.

The graphic on the next page, from the 1970 DFG report on the 1961-64 San Joaquin Chinook crash,³⁵ shows the Delta flows after Decision D990 but before Decision D1275. The first graphic shows normal flows in the absence of exports by the Bureau of Reclamation. In this case, all of the internal Delta channel flows are towards the ocean. The second graphic shows Old and Middle River flows reversed towards the pumps, and the third shows San Joaquin River flows in the Central Delta reversed, as well as Old and Middle River flows.

The map on the following page shows a closeup of the western Delta. Normally water that flows into the channels of the Delta from the Sacramento River via Georgiana Slough and the Delta Cross Channel, the San Joaquin River, and the Mokelumne River, flows out through Threemile Slough and Jersey Point, joining the lower Sacramento River at Chipps Island.

However, a reversal of normal Delta channel outflows through Threemile Slough and the mouth of the San Joaquin River can occur. The 1970 DFG report described this reversal:

"The State's 10,000 cfs Italian Slough Pumping Plant near the Tracy plant is now taking a relatively small amount of water. Long before it reaches full operating schedule there will be flow reversal every year and, in most years, it will continue late in the season. Under these conditions, an even more extreme form of flow reversal could occur during the salmon migration period. When the Sacramento River flow is low and the pumps are taking more Sacramento water than will flow through the Delta Cross Channel and Georgiana Slough, the balance must come through Threemile Slough and by Sacramento [River] water flowing upstream from the mouth of the San Joaquin, thus resulting in a reversal of all flows in the San Joaquin from its mouth upstream to Old River heading."³⁶

[underlining added]

³⁵ Hallock, Elwell, and Fry, California Department of Fish and Game, Migrations of Adult King Salmon *Oncorhynchus tshawytscha* In The San Joaquin Delta As Demonstrated by the Use of Sonic Tags, 1970. Available at <http://www.escholarship.org/uc/item/9wr0s10v>

³⁶ Ibid.

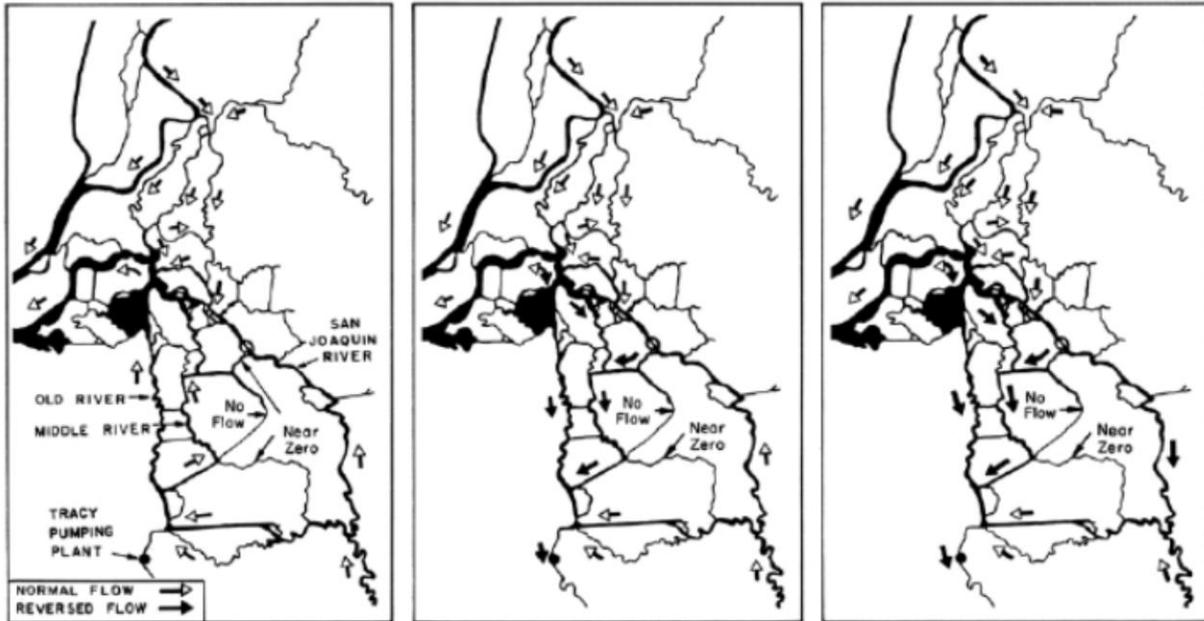
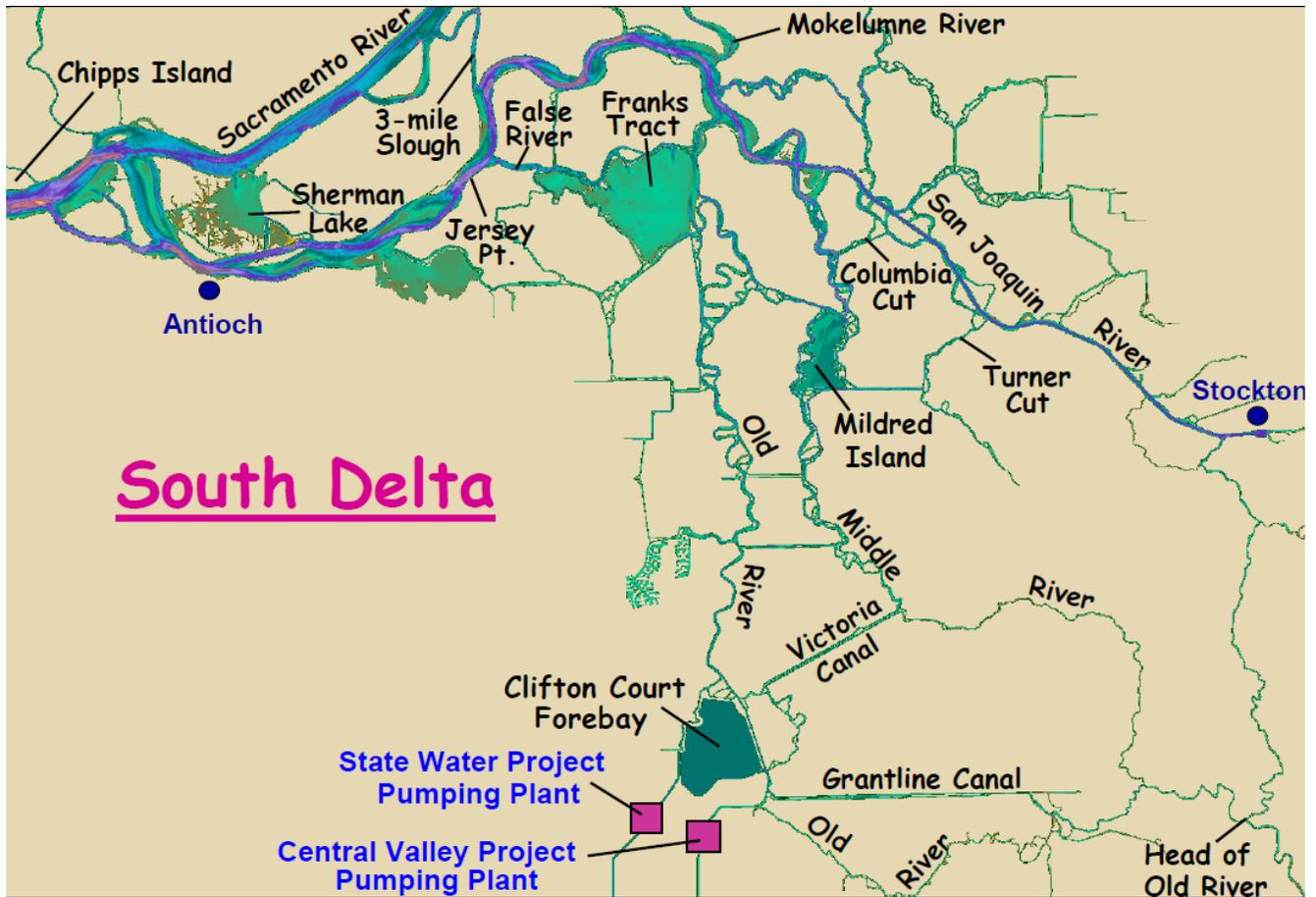
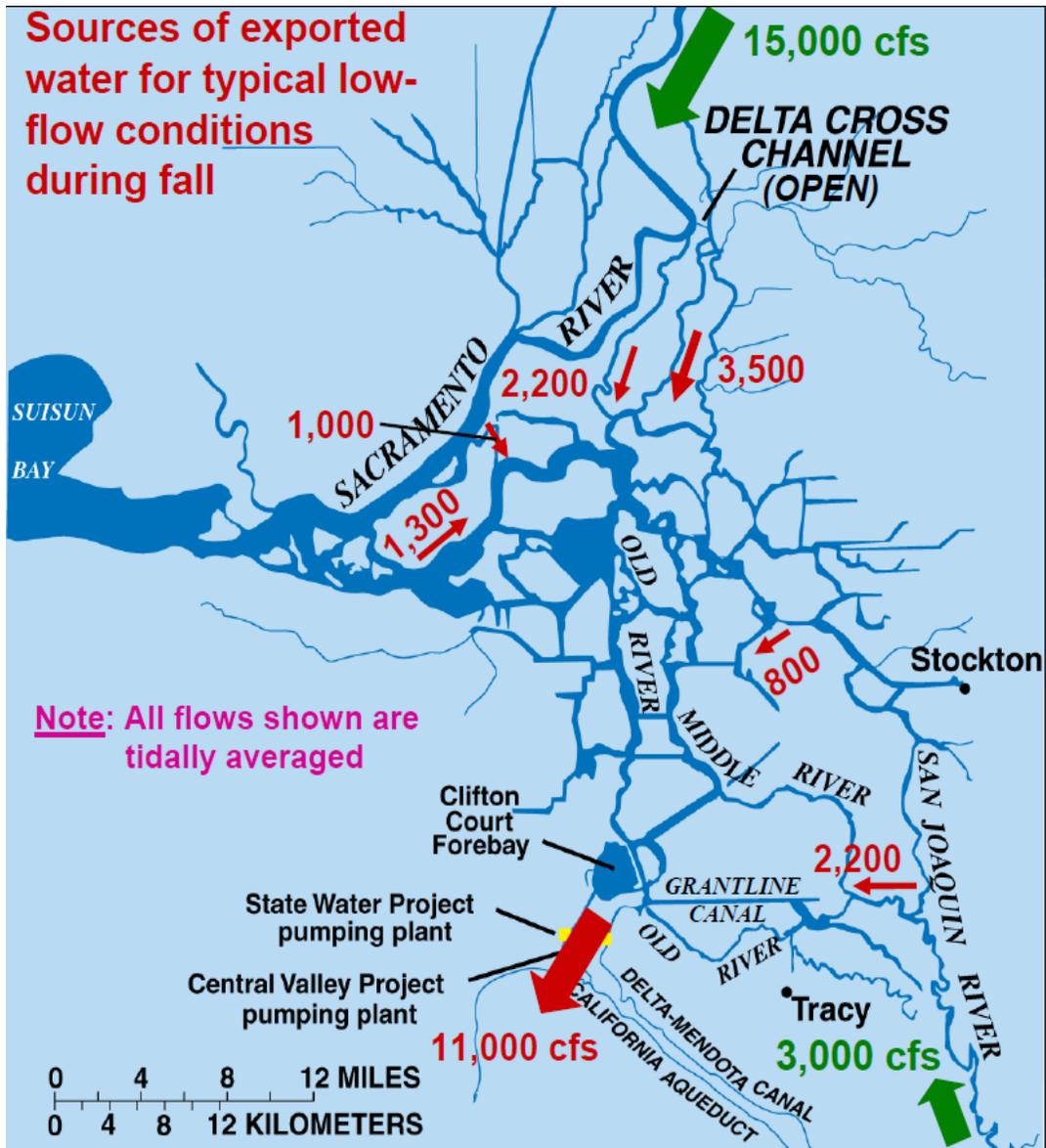


FIGURE 2. Direction of currents in the Sacramento-San Joaquin Delta. Tidal reversals not shown.
 LEFT: Normal flows. Tracy Pumping Plant not taking water.
 CENTER: With pumping. Old and Middle rivers have reversed, but San Joaquin River still flows normally.
 RIGHT: San Joaquin River has reversed.



The graphic below, from a 2007 workshop presentation by Pete Smith of the USGS, shows reversal of normal Delta channel outflows to the lower Sacramento River.³⁷ When these flows are reversed, there is a net negative outflow from all the channels of the Delta. This happens when the total Delta exports are greater than the normal total inflow to the Delta channels from all sources, including the Sacramento, San Joaquin, and Mokelumne. In other words, by reversing the flow at the mouth of the San Joaquin River, the pumps can export over 100% of the water that would normally be flowing through the Delta channels.

³⁷ Pete Smith, USGS, Hydrodynamic Issues Related to Options for Through-Delta Conveyance, CALFED Science Program Workshop #2, Through-Delta Conveyance, September 11, 2007. Available at http://science.calwater.ca.gov/pdf/workshops/workshop_dci2_presentation_04_smith.pdf



Compare these fall flows with the 1964 flows to see the extreme reversal of normal outflow from the Delta channels to the lower Sacramento River.

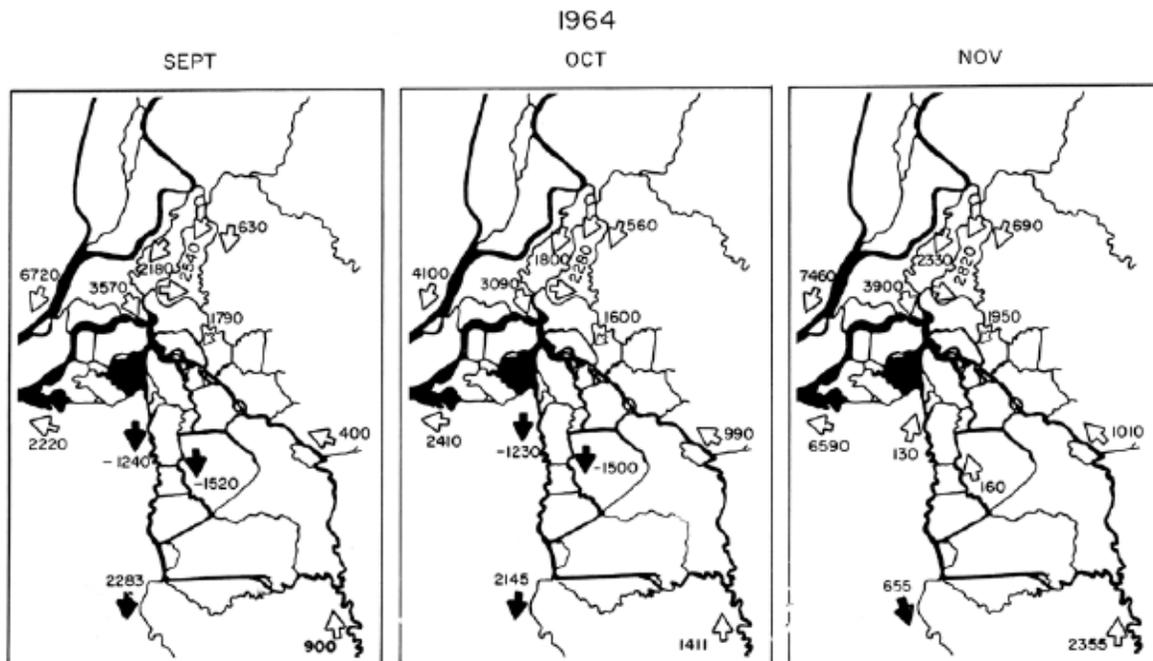
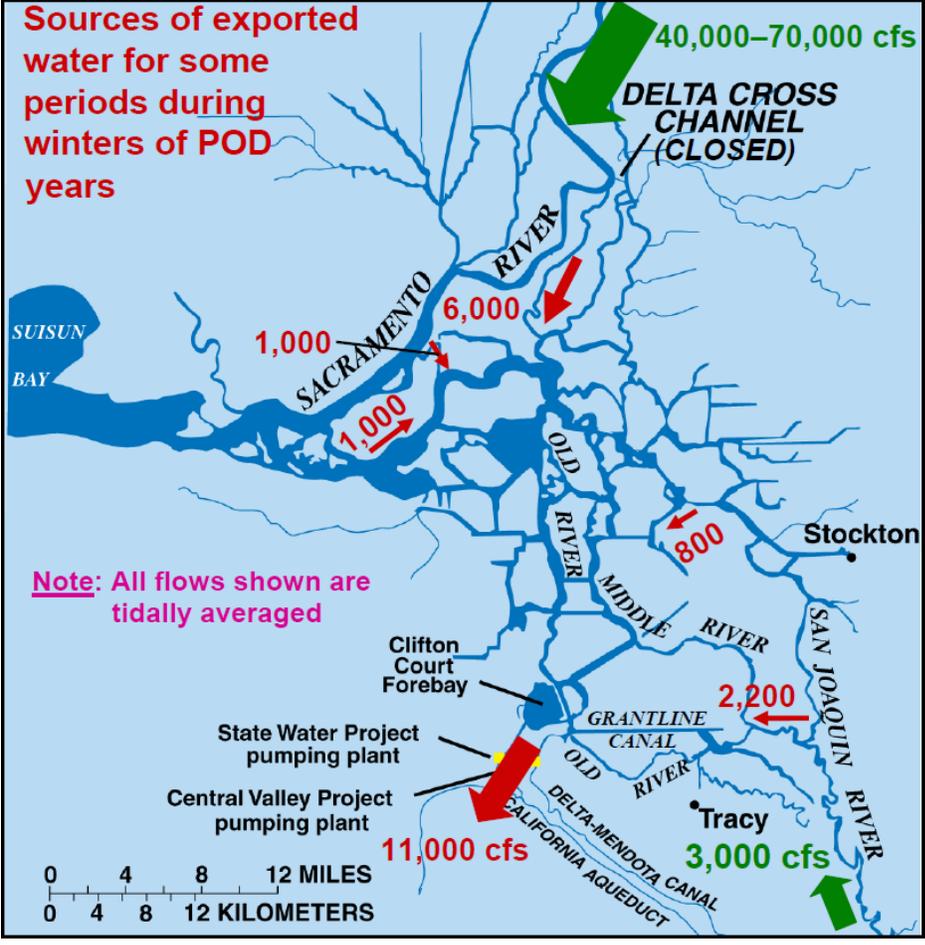


FIGURE 3. Rate (cf) and direction of mean monthly net flows in the Sacramento-San Joaquin Delta, all of 1964. Open arrows indicate flows in normal direction, solid arrows indicate reversed flows.

In addition, during the POD years, the flow reversal started happening at times even in the winter. Thus over 100% of the water that would normally be in the Delta Channels was exported for much of the year. (See below.)



USGS Measurements of Net Delta Outflow

The USGS definition of Net Delta Outflow includes the flow of the Sacramento River past Rio Vista:

$$NDO = \text{Rio Vista} + \text{Three Mile Slough} + \text{Jersey Point} + \text{Dutch Slough}$$

where

$$\text{Rio Vista} = \text{flow of the Sacramento River at Rio Vista}$$

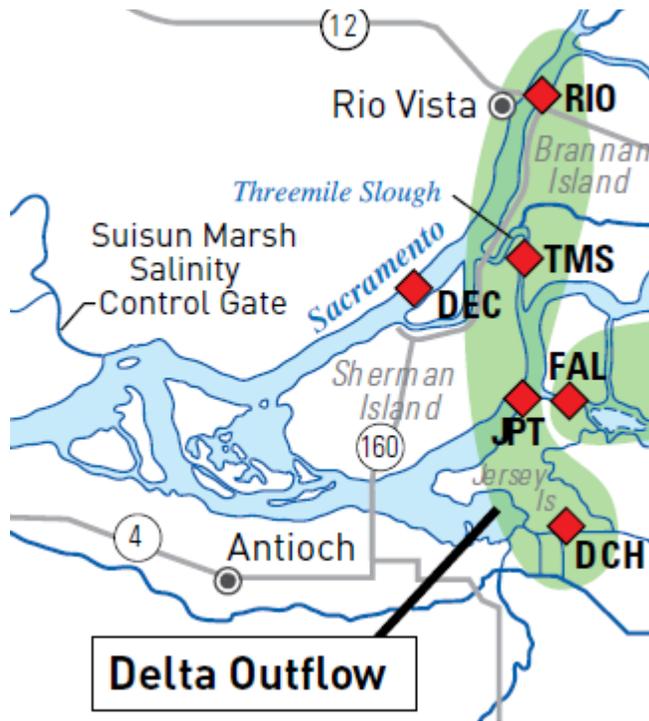
And the flows through Three Mile Slough, Jersey Point, and Dutch Slough in the Western Delta are the net outflow from the channels in the Delta. They are measured at the following USGS stations:

$$\wedge \text{ Three Mile Slough} = \text{Three Mile Slough (TMS)}$$

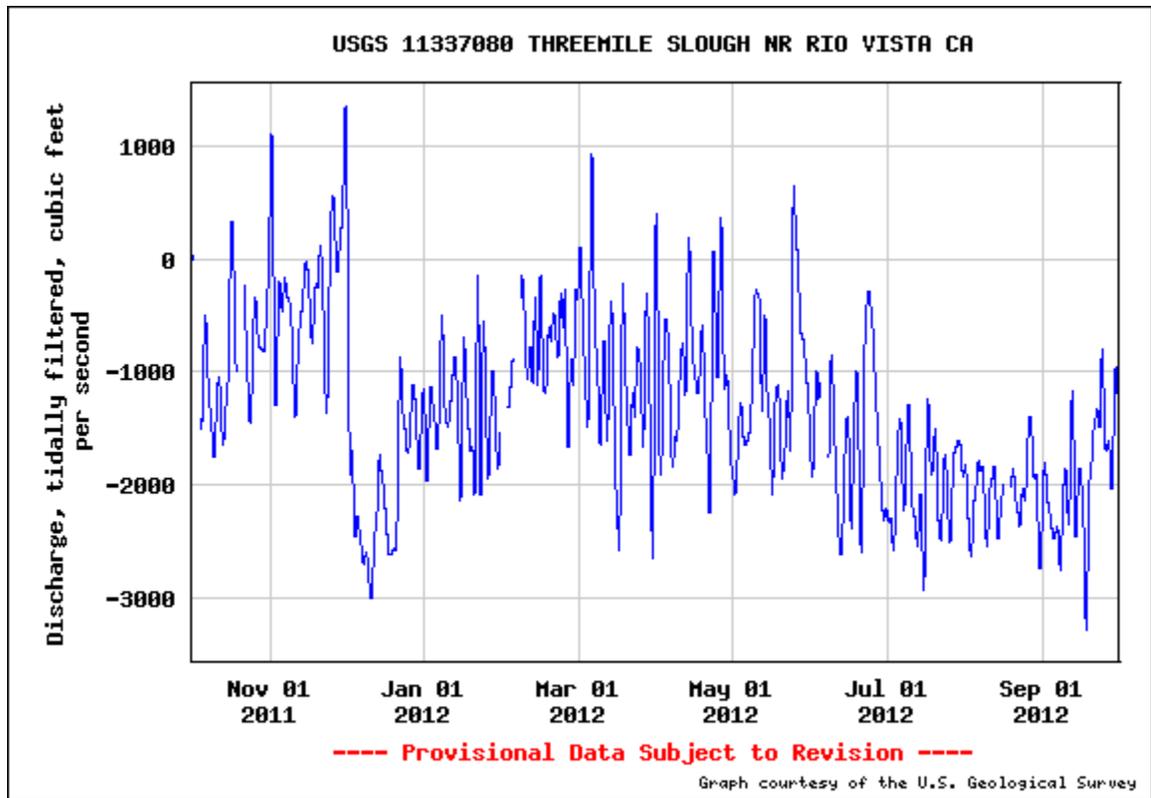
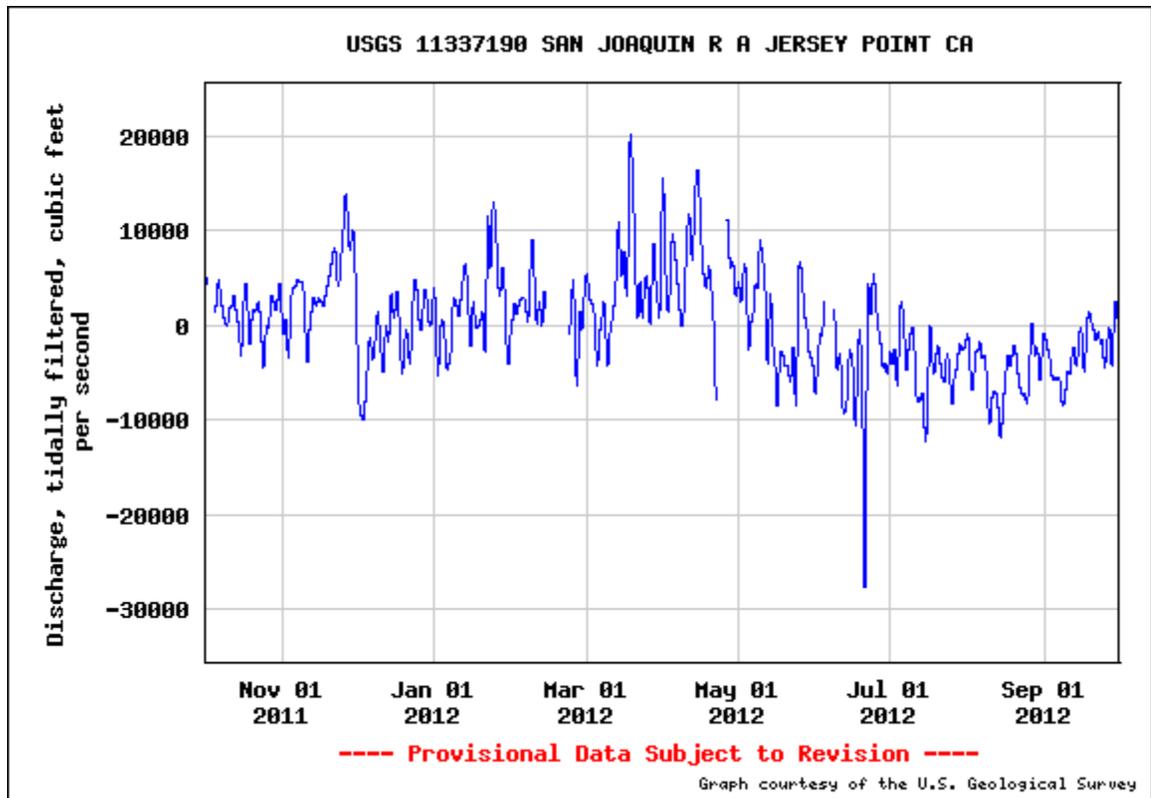
^ Jersey Point= San Joaquin River at Jersey Point (JPT)

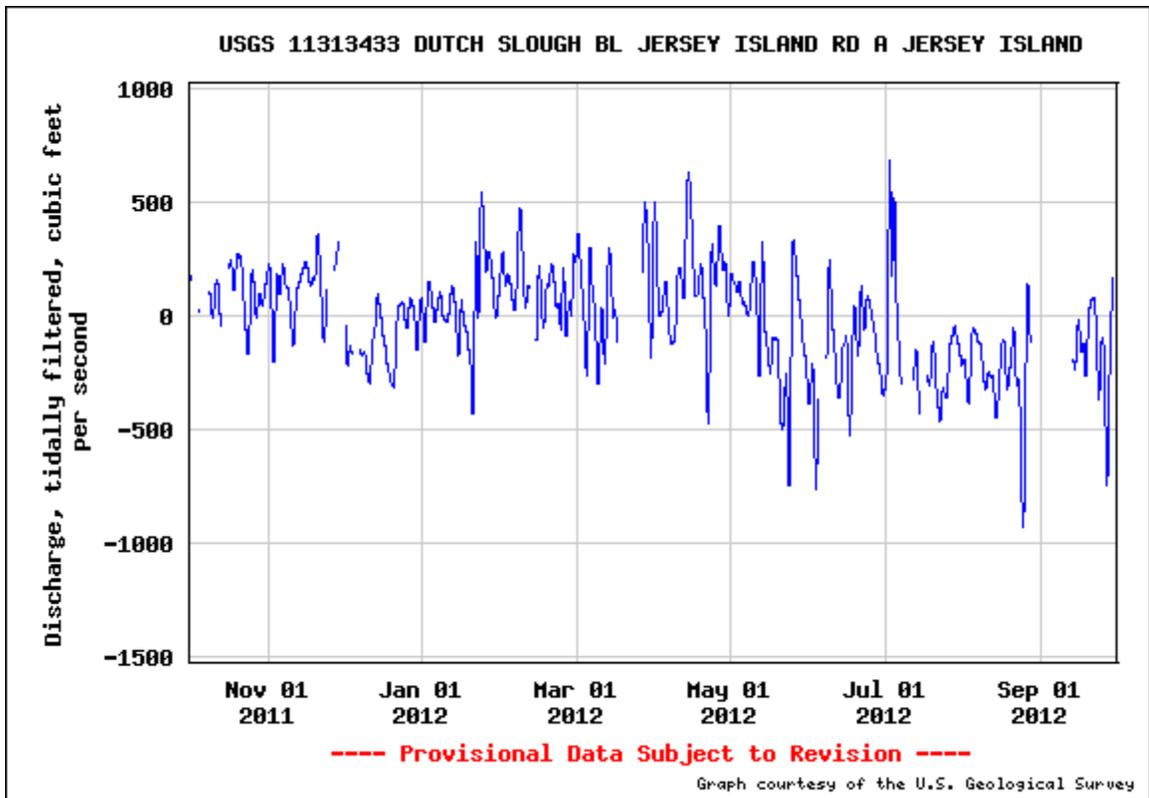
^ Dutch Slough = Dutch Slough at Jersey Island (DCH)

The map below shows the location of the stations on the Sacramento River and in the Western Delta.

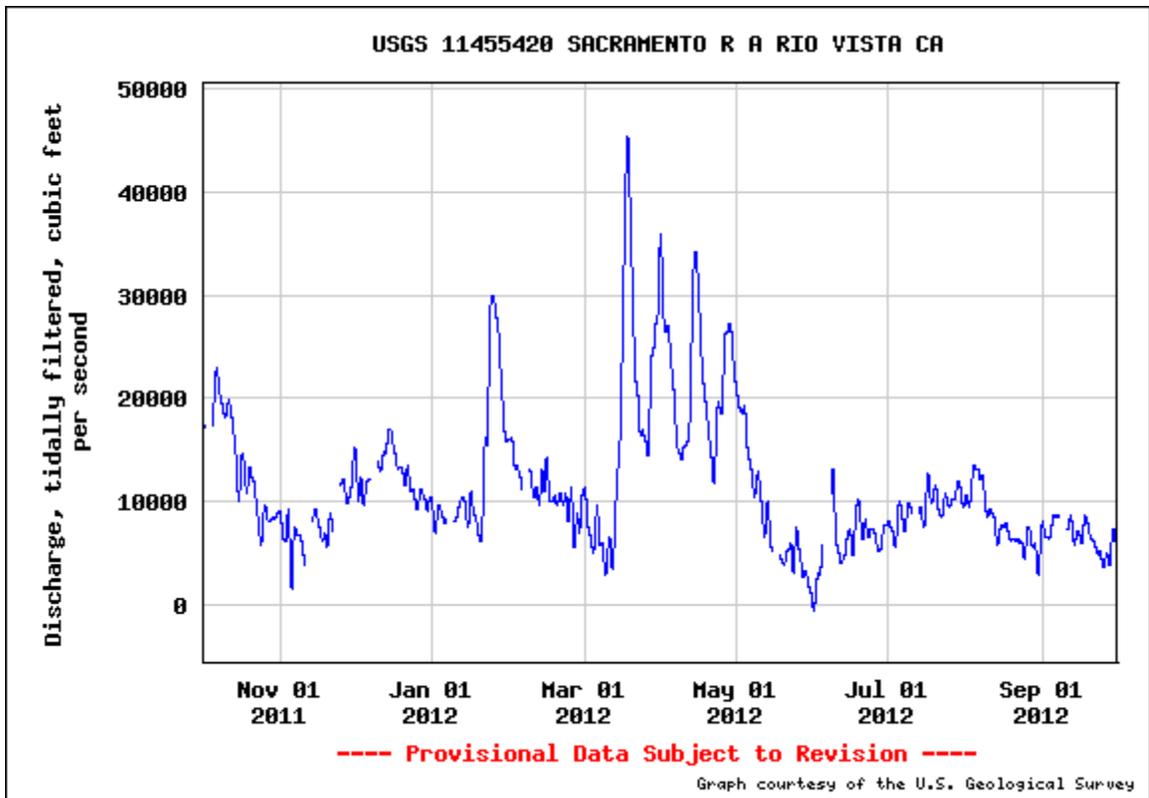


The graphs below show the negative flows measured at the Western Delta stations in Water Year 2011-12:



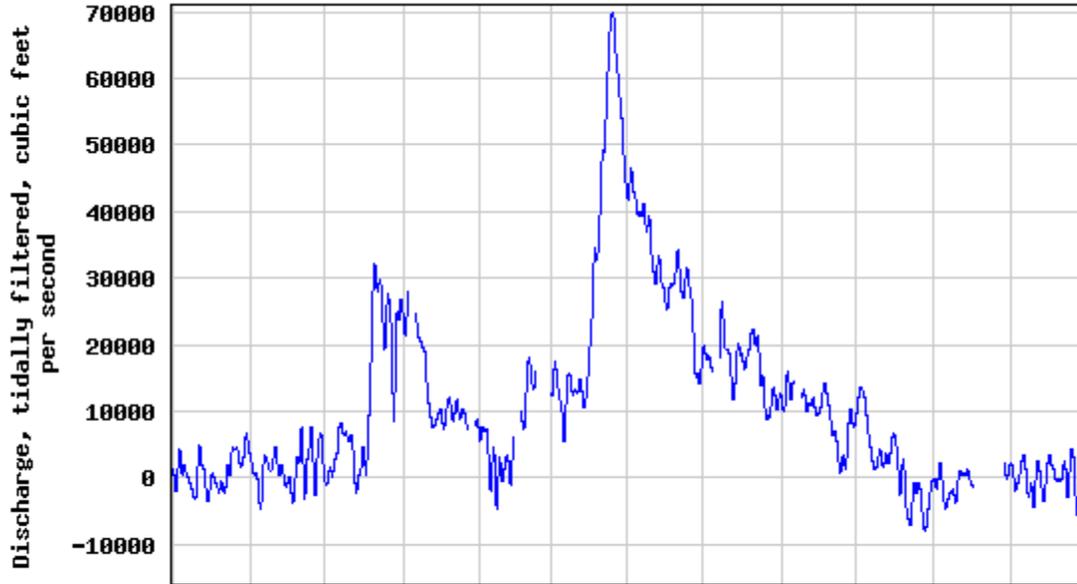


This was the Sacramento River flows past Rio Vista in WY 2011-2012:



It is difficult to see how the Net Delta Outflow (including the flows at Rio Vista) was even positive for much of the summer. In Water Year 2010-11, the Western Delta flows were positive more of the time, but still negative in the summer:

USGS 11337190 SAN JOAQUIN R A JERSEY POINT CA

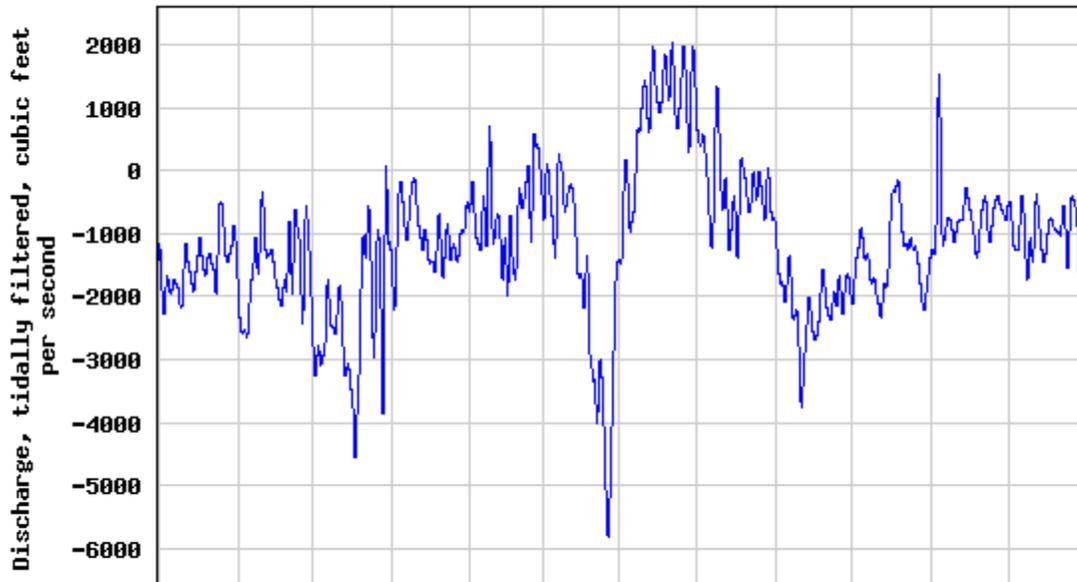


Oct 01 Nov 01 Dec 01 Jan 01 Feb 01 Mar 01 Apr 01 May 01 Jun 01 Jul 01 Aug 01 Sep 01
2010 2010 2010 2011 2011 2011 2011 2011 2011 2011 2011 2011

----- Provisional Data Subject to Revision -----

Graph courtesy of the U.S. Geological Survey

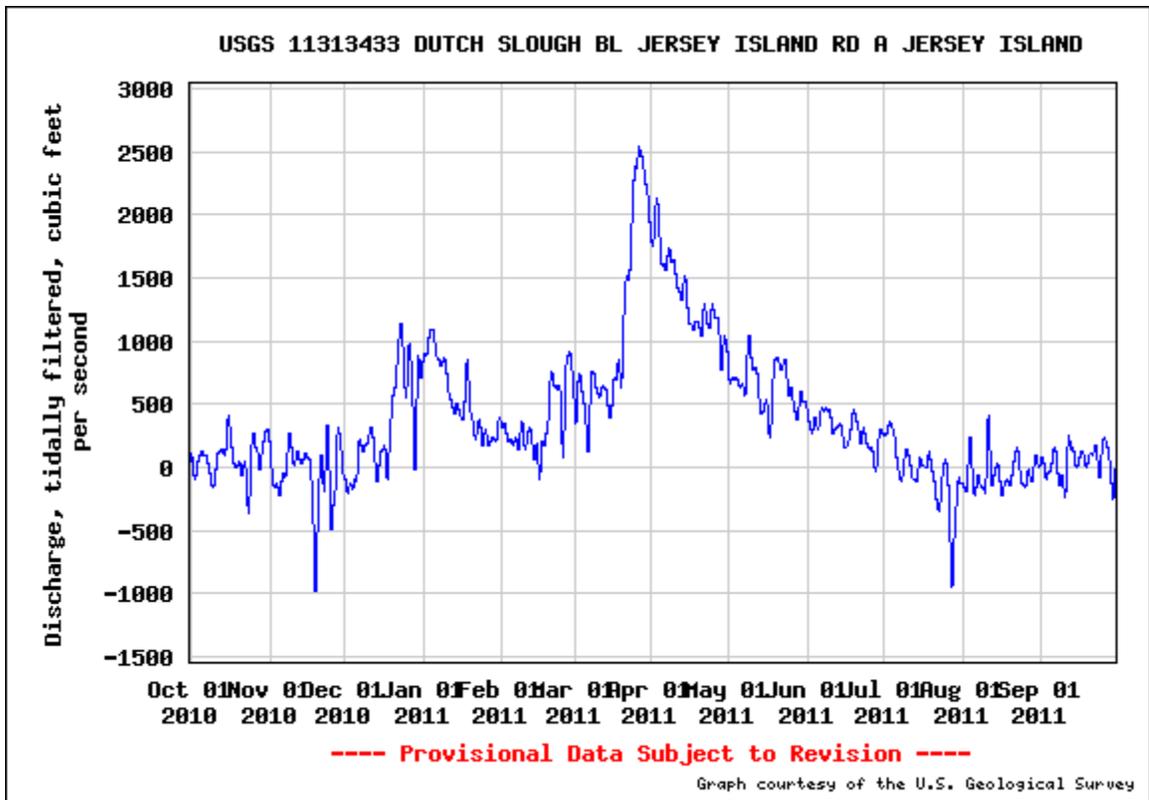
USGS 11337080 THREEMILE SLOUGH NR RIO VISTA CA



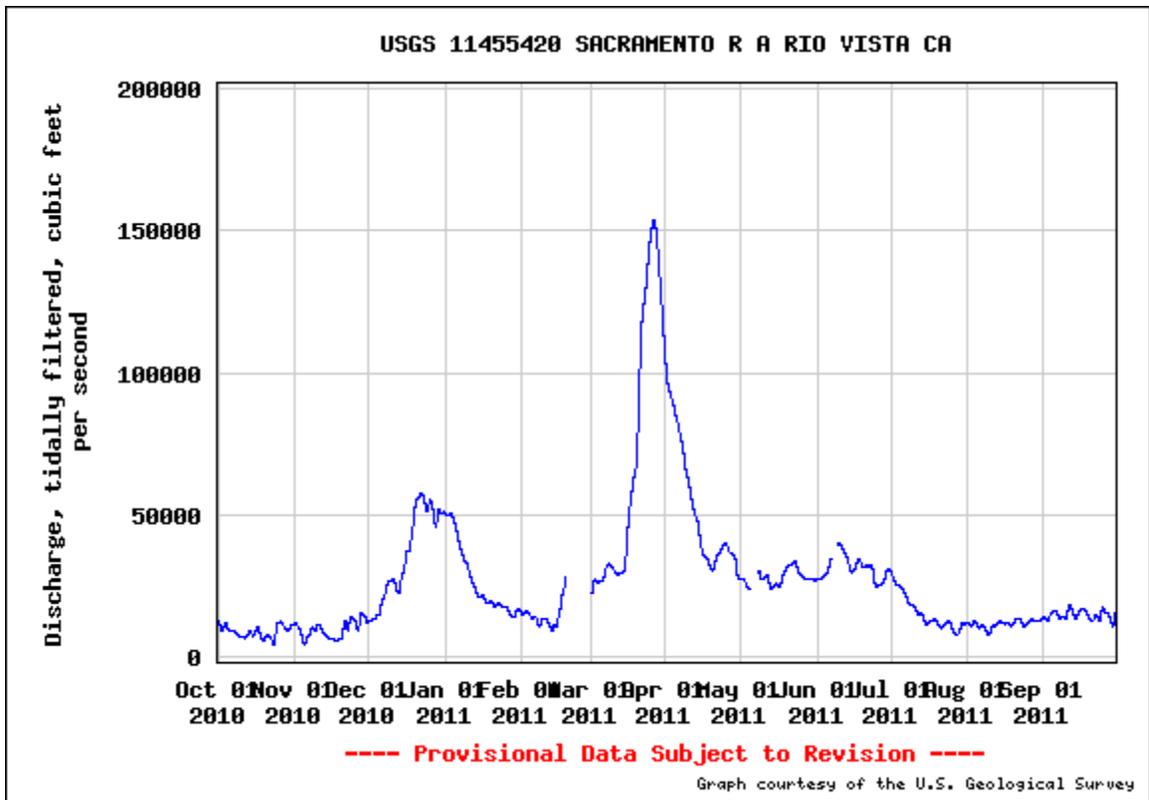
Oct 01 Nov 01 Dec 01 Jan 01 Feb 01 Mar 01 Apr 01 May 01 Jun 01 Jul 01 Aug 01 Sep 01
2010 2010 2010 2011 2011 2011 2011 2011 2011 2011 2011 2011

----- Provisional Data Subject to Revision -----

Graph courtesy of the U.S. Geological Survey

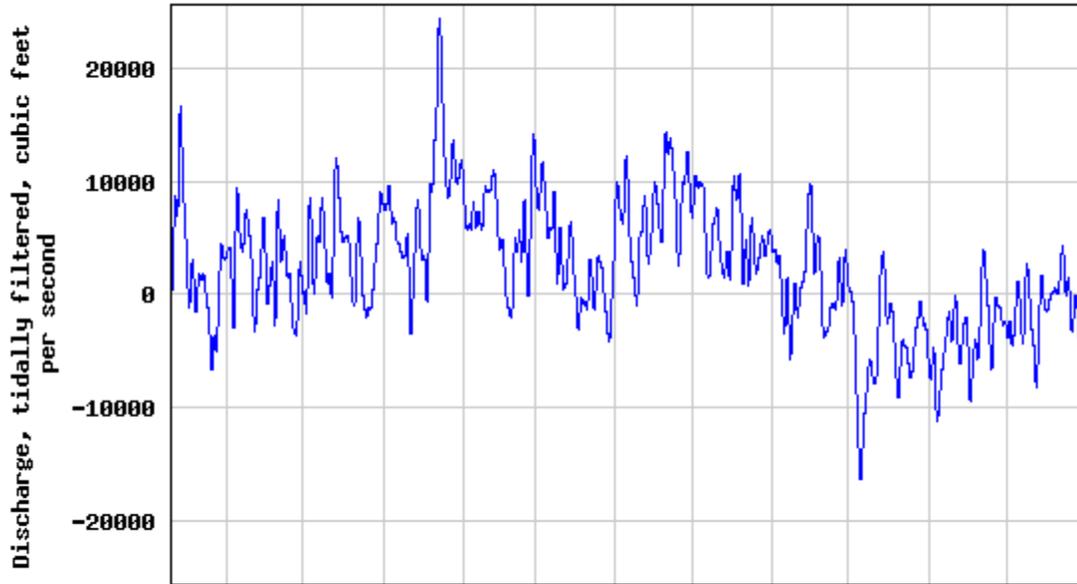


The Sacramento River flows past Rio Vista were huge in the spring, and substantial even through the summer:



These were the flows in the Western Delta in 2009:

USGS 11337190 SAN JOAQUIN R A JERSEY POINT CA

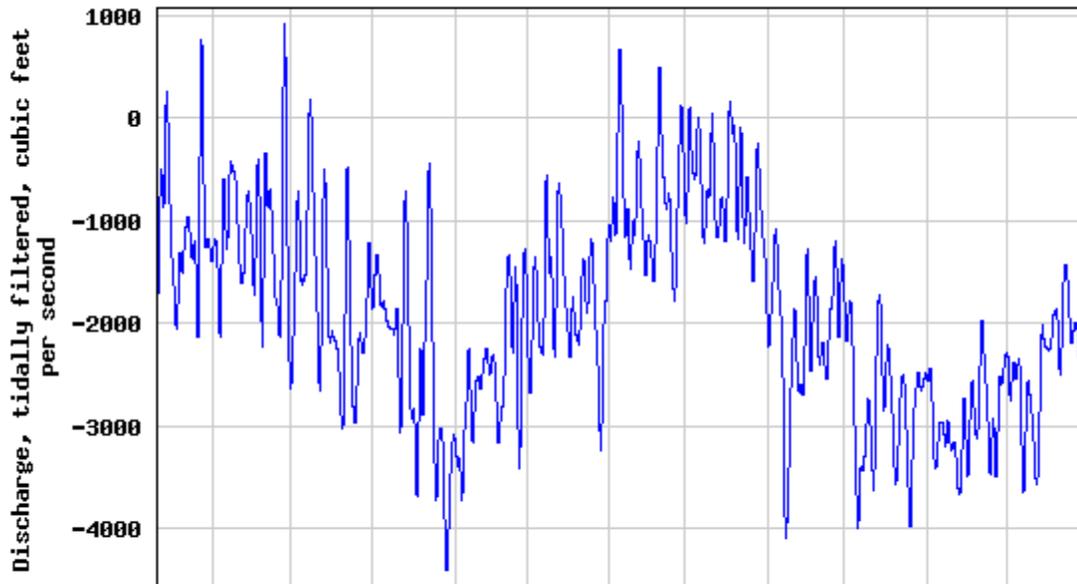


Nov 01 Dec 01 Jan 01 Feb 01 Mar 01 Apr 01 May 01 Jun 01 Jul 01 Aug 01 Sep 01
2009 2009 2010 2010 2010 2010 2010 2010 2010 2010

----- Provisional Data Subject to Revision -----

Graph courtesy of the U.S. Geological Survey

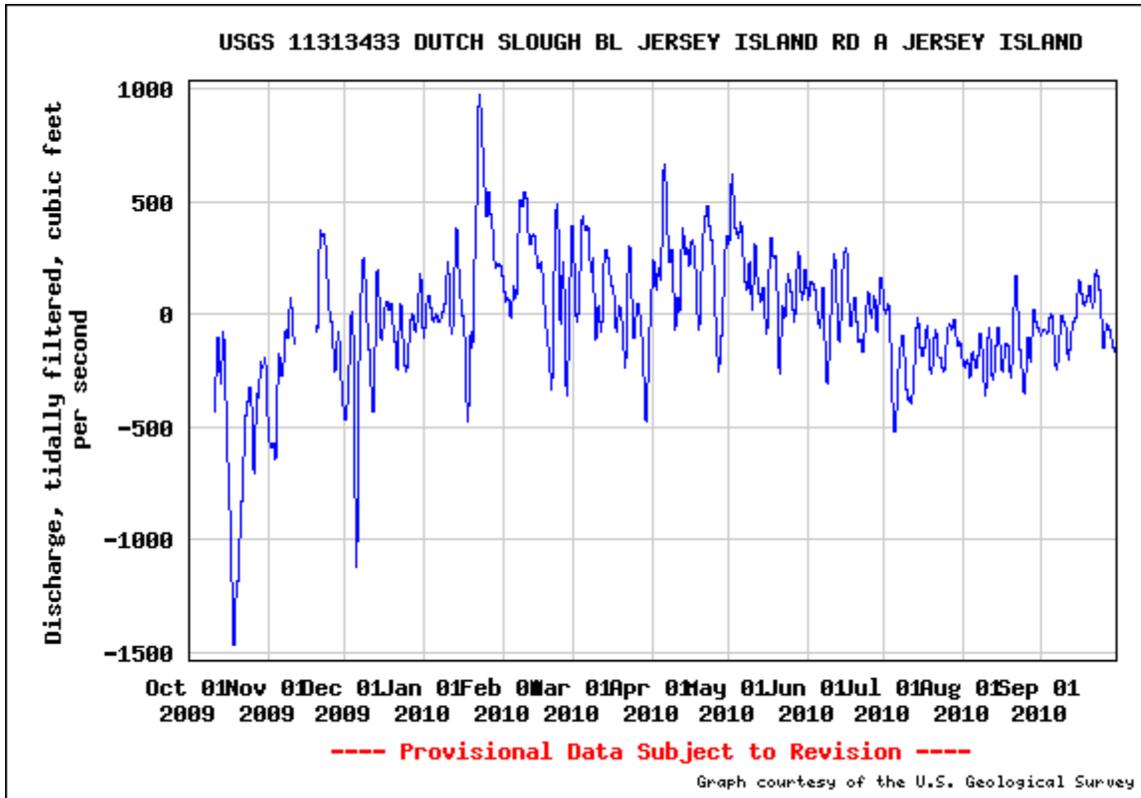
USGS 11337080 THREEMILE SLOUGH NR RIO VISTA CA



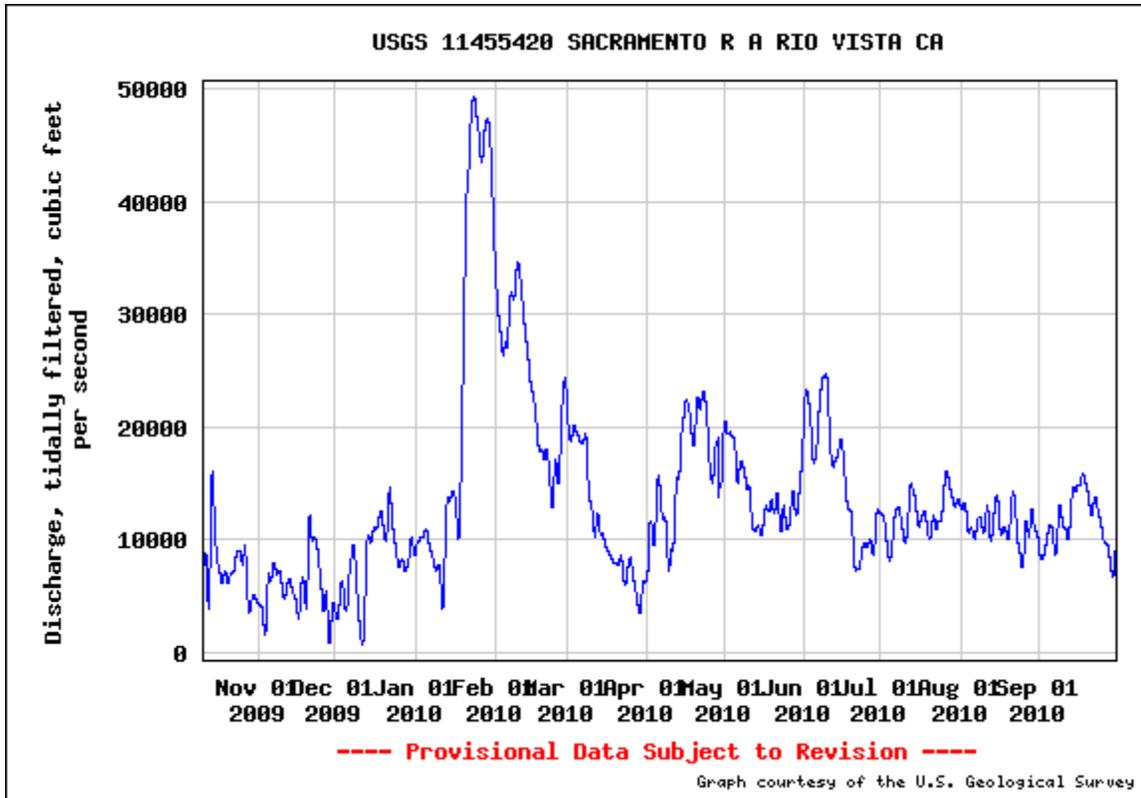
Nov 01 Dec 01 Jan 01 Feb 01 Mar 01 Apr 01 May 01 Jun 01 Jul 01 Aug 01 Sep 01
2009 2009 2010 2010 2010 2010 2010 2010 2010 2010

----- Provisional Data Subject to Revision -----

Graph courtesy of the U.S. Geological Survey



The Sacramento River flows past Rio Vista were above 10,000 cfs in the summer of 2009, but still may not have been large enough to provide a positive Net Delta Outflow.



Permits for diversions on the Sacramento River

In Decision D990, the Bureau’s applications to divert unstored water along the Sacramento River from Shasta Dam to the Delta and in the channels of the Delta were as follows:³⁸

Application	Diversion Rate	Storage Quantity
9363	1,000 cfs	310,000 af/year
9364	9,000 cfs	3,000,000 af/year

There was also an application to divert water at the Bureau’s Old River intake at the Tracy pumping plant in the Delta.

Application	Diversion Rate	Storage Quantity
9368	4,000 cfs	none

³⁸ State Water Rights Board, Decision D 990, p. 11, Adopted Feb 9, 1961.

These were the proposed diversion points on the Sacramento River and their capacities:³⁹

Bella Vista	93 cfs	Cow Creek Area
Corning Pumping Plant	2200 cfs	Corning & Tehama-Colusa Canals
Chico Canal	310 cfs	East side of Sacramento Valley
Delta Cross Channel	7600 cfs	Southern Delta

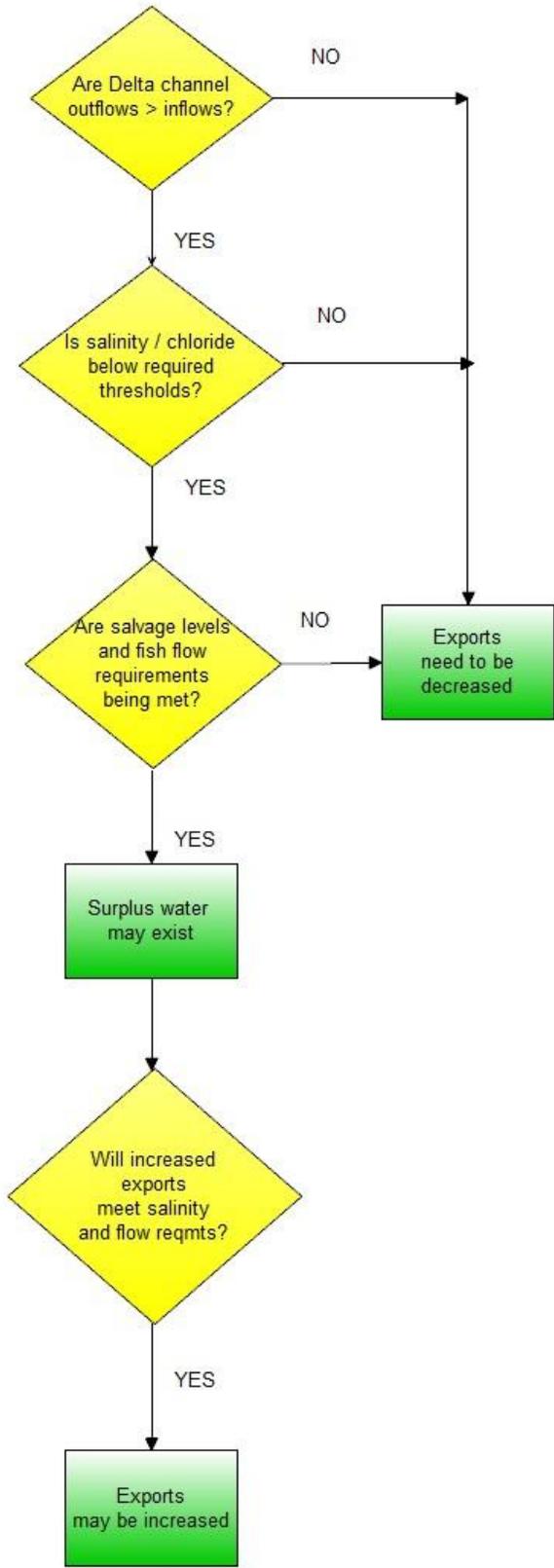
The Department of Water Resources has no permits for diversions on the Sacramento River. The sole water supply for direct diversions in the Delta is listed as “the channels of the Delta.”

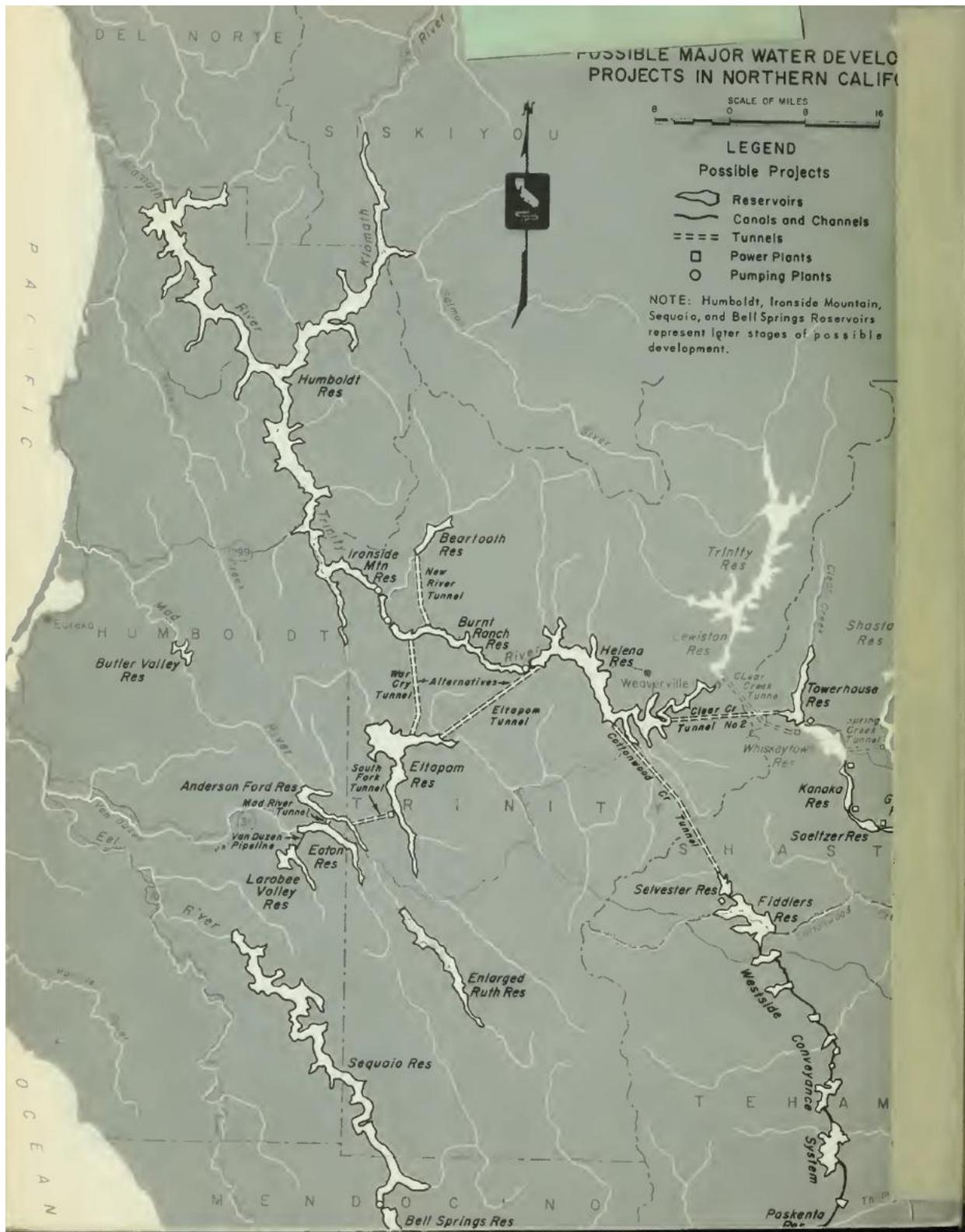
The permits issued by the Board in Decision D990 and D1275 do not consider the possibility that pumping in the Delta could become so extreme that the San Joaquin River would be made to flow backwards, and effectively act as a point of diversion for waters from the main stem of the lower Sacramento River. It is clear that such diversions are being made, and, if included in the Bureau’s diversions “along the Sacramento River”, would greatly exceed the Bureau’s permitted diversions.

These diversions, which effectively divert far in excess of 100% of the natural inflow to the Delta, have had a huge and negative effect on the Delta estuary, and particularly on the fish and wildlife in the Delta. Fisheries and aquatic life are a beneficial use of the waters in the Delta, and the Board needs to take steps to ensure that diversions are more in line with actual supplies in the channels of the Delta.

The Board needs to revisit the issue of the direct diversions in the Delta by the Bureau and the Department of Water Resources and lack of water supply for these diversions. Rather than allowing diversions at the Delta pumps which greatly exceed the natural water supply in the Delta, including upstream releases that enter through Georgiana Slough and the Delta Cross Channel, the Board should consider requiring a test for “surplus conditions” in the channels of the Delta, which explicitly considers outflow from the channels of the Delta. A suggestion for an algorithm is given on the next page.

³⁹ Decision D990, p. 16





California Water Resources Exhibit List #1

Water Supply for Diversions in the Delta

by the Central Valley Project and the State Water Project

1. Report on 1956 Cooperative Study Program: Water Use And Water Rights Along [The] Sacramento River And In [The] Sacramento-San Joaquin Delta, US Department of Interior, Bureau of Reclamation, State of California, Department of Water Resources, Sacramento River and Delta Water Association, 1957, Vol. I – text
2. Report on 1956 Cooperative Study Program: Water Use And Water Rights Along [The] Sacramento River And In [The] Sacramento-San Joaquin Delta, US Department of Interior, Bureau of Reclamation, State of California, Department of Water Resources, Sacramento River and Delta Water Association, 1957, Vol. I – tables
3. Report on 1956 Cooperative Study Program: Water Use And Water Rights Along [The] Sacramento River And In [The] Sacramento-San Joaquin Delta, US Department of Interior, Bureau of Reclamation, State of California, Department of Water Resources, Sacramento River and Delta Water Association, 1957, Vol. I – maps and charts
4. Bancroft Library, Regional Oral History Office, Governmental History Documentation Project, Goodwin Knight / Edmund Brown, Sr., Era: California Water Issues, 1950-1966, William E. Warne, Administration of the Department of Water Resources 1961-66
5. California Department of Water Resources, Bulletin 76-81, Status of Water Supply Augmentation Plans
6. California Department of Water Resources, Bulletin 151-65, Water Progress in California, July 30, 1962- June 30, 1965
7. California Department of Water Resources, North Coastal Area Investigation, 1964.
8. California Department of Water Resources, California Water Plan, 1970.
9. Progress on Incorporating Climate Change into Management of California's Water Resources. Department of Water Resources, 2006
10. Francis Chung, An Assessment of CVP-SWP Performance Under Alternative Delta Regulations, Infrastructure and Climate Change Scenarios Regarding CAISIM II, California Water and Environmental Modelling Forum, Feb 22, 2010.
11. Hallock, Elwell, and Fry, California Department of Fish and Game. Migrations of Adult King Salmon *Oncorhynchus tshawytscha* In The San Joaquin Delta As Demonstrated by the Use of Sonic Tags, 1970.

12. Pete Smith, USGS, Hydrodynamic Issues Related to Options for Through-Delta Conveyance, CALFED Science Program Workshop #2, Through-Delta Conveyance, September 11, 2007